II. IMPINGEMENT AT MONROE POWER PLANT

A. Sampling Methods Used by Detroit Edison

The methods used for impingement sampling are stated on p. 4.3-1 of the 316(b) as follows (Detroit Edison 1976a):

> **Fish impingement monitoring began for Units 1, 2, 3, and 4 in April 1972, June 1972, March 1973, and May 1974, respectively. As stated in Subsection 3.2.2.1.3, the traveling screens are rotated and washed automatically every 24 hours, and more frequently when increased loading dictates. In order to obtain a representative sample, at the end of a daily washing a basket was placed in position at the end of the sluiceway. After a 24-hour period, all the fish collected in the basket were counted and identified. Representative specimens were weighed, measured, and checked for deformities. Attempts were made to collect a minimum of one sample each week.**

1. Location

The Monroe plant has 16 intake screenwells, each containing a 3/8-in. mesh traveling screen (Fig. 2). Detroit Edison divided the impingement data from these screenwells into two categories: counts from 2 test screenwells and counts from 14 nontest screenwells. The test screenwells were those in Unit 2 in which prototype fish pumping systems (referred to on the impingement data sheets as the "north collector" and the "south collector") were installed to remove fish before they were actually impinged. The fish impinged on the two test screens were counted and recorded separately from those impinged on the 14 nontest screens. The impinged fish from the nontest screens (the remaining six screens in Screenhouse 1 and the eight screens in Screenhouse 2) were washed into a common sluiceway in each screenhouse and collected en masse in a collection basket at the end of each sluiceway.

2. Gear

The mesh size of the collection baskets is not given in the 316(b), but according to Detroit Edison, it was approximately 1/4-in., which would be sufficiently fine to retain the smallest fish washed into it from the 3/8-in. mesh of the traveling screens. The above excerpt from the 316(b) says only that "representative" samples were collected and that all the fish washed into the basket were counted. It does not specifically state that all of the fish impinged on the traveling screens during a 24-h period were washed into the collection basket. Therefore, all of the impinged fish may not have been counted.

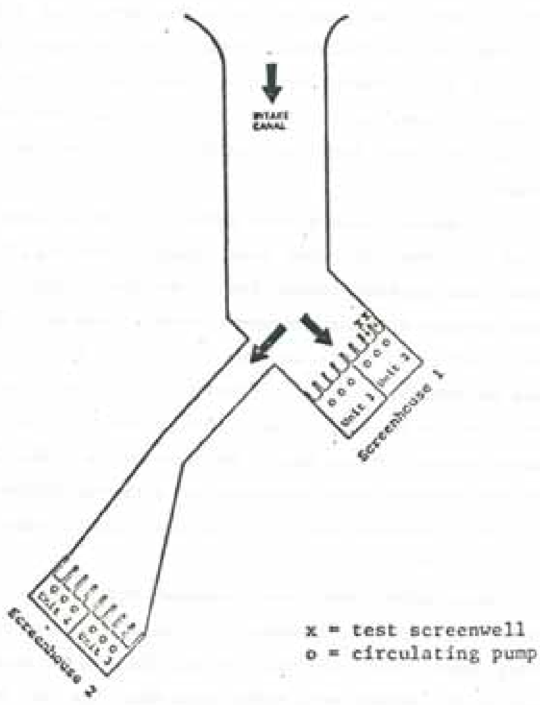


Figure 2. Monroe Power Plant, indicating location of test screenwells. Adapted from 316(b) Figure 4.4-1.

The above excerpt from the 316(b) states that representative specimens were measured but presents no data to show that these specimens were actually representative of the collection basket catch. The specimens must be representative of the impinged fish in order to show what age classes are being impinged. The 316(b) also presents no length-frequency distribution of the impinged fish to demonstrate the size selectivity of the traveling screens (i.e., the smallest size fish that is impinged) and to show that all age classes of impingeable fish are being sampled.

The 316(b) presents no description of the procedure for cleaning the trash racks in front of the traveling screens and no report of the kinds and numbers of fish, if any, removed from the trash racks (vertical steel bars spaced 3 in. apart). Some large fish therefore could have been impinged on these racks but not considered in the impingement estimates.

3. Schedule

The daily impingement data sheets obtained from Detroit Edison show that during June 1975-May 1976 (the year analyzed for impact in the 316(b)) the test screens were checked almost daily, Monday-Friday. The number of counts from the nontest screens, however, ranged from only 2 in August 1975 to 10 in November 1975 and April and May 1976. The screens were not monitored during the week of February 15-21. Otherwise, fish were usually counted from either the test or nontest screens more often than once a week, the minimum frequency stated in the above 316(b) excerpt. The 316(b) does not state that the screens were monitored on a pre-established schedule; thus, the monitoring schedule may not have been established in advance of observed screen loadings.

The daily impingement data sheets suggest that a major deficiency of Detroit Edison's monthly impingement estimates is that most of them are based on samples taken from only half of the plant's 16 screens. On 51% of the sampling days, counts were taken from only the two test screens. The test screens are located adjacent to one another in Screenhouse 1 (Fig. 2), and the 316(b) presents no evidence that impingement on these two screens was representative of impingement on the other 14 intake screens. Counts from the nontest screens were usually made for only Screenhouse 1 because, according to a Detroit Edison representative, the collection basket for Screenhouse 2 was often under water. Of 82 basket counts from nontest screens, 66 sampled fish only from Screenhouse 1 and 11 sampled fish only from Screenhouse 2. Sampling of impinged fish from Screenhouse 2 occurred only from January-May 1976. Fish were sampled simultaneously from both screenhouses and, therefore, impingement throughout the entire plant was measured on only 5 days during the year, and these 5 days occurred only during the month of April 27-May 27, 1976. Detroit Edison did not demonstrate that impingement data from the two screenhouses could be used interchangeably to estimate impingement occurring in the whole plant. The estimate for impingement at the Monroe plant is consequently heavily weighted to reflect impingement in Screenhouse 1. The effect of this bias on the estimate is not known.

B. Data Analysis

1. Verification of 316(b) impingement estimates

Although the 316(b) presents impingement data from the Monroe plant for 1972-76, we attempted to verify only the 1975-76 data because these were the data considered in the 316(b) impact analysis. Also, the plant did not become fully operational until mid-1974 and impingement in the earlier years would not be directly comparable to that occurring during full operation.

Table 4.3-1 from the 316(b) shows Detroit Edison's estimates of impingement at the Monroe plant from June 1975-May 1976.

TABLE 4.3-1 FISH IMPINGEMENT EXTRAPOLATIONS AT THE MONROE POWER PLANT, JUNE 1975 THROUGH MAY 1976

	1975							1976						
Species	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Totals	% of Total
Gizzard shad	71	17550	40814	18879	15801	29050	83230	100779	143463	26497	11359	8154	500560	58.1
Alewife	777	211	7	81	1258	627	75	8		432	1658	5583	10790	1.3
Rainbow smelt	122	53		8	1928	2640	644	227	609		158	322	6711	0.8
Shiners	14454	10184	11613	12831	12679	6056	8147	6590	6889	2688	8668	9348	109527	12.7
Trout-perch	783	27	51	120	273	46	15	616	848	601	1868	87	5471	0.6
Logperch	47	52	37	140	369	227	39	4		6	63	136	1116	0.1
Walleye	6	109	121	58	6	36	14		51	8	12	3	456	<0.1
Yellow perch	47391	8814	35551	12042	4164	1874	1348	1838	2378	852	3777	454	122301	14.2
White bass	206	3649	13442	12671	5229	734	366	122	224	23	160	74	37235	4.3
Channel catfish	60	46	64	206	31	10	186	79	354	15	29	20	1128	0.1
Coho salmon	2												2	<0.1
Rock bass	64	28	21	27	15	9	29		5	43	83	56	380	<0.1
Smallmouth bass			3	4	2	16					3	6	34	<0.1
Freshwater drum	7704	3187	14021	17789	10348	1504	2458	487	1227	129	738	1051	60648	7.0
White crappie	4		31	25	31	23	35	25	34	2	46	19	286	<0.1
Sunfish	73	129	37	61	83	74	169	38	20	36	34	29	783	0.1
Northern pike	30	30		11			3		7	7	15	6	109	<0.1
Brown bullhead	4	2										2	8	<0.1
Yellow bullhead				6		3		24	10	16	4	9	75	<0.1
Goldfish	73	77	102	53	10	8	85	485	639	685	436	62	2714	0.3
Largemouth bass	2		3		6		7					6	24	<0.1
Chinook salmon	3	1				3				3			10	<0.1
Carp		2		11		3	8	36	441	35	14	3	552	0.1
Suckers		5		21	2					5	3	5	41	<0.1
Others	3			8	2					5	12	2	32	<0.1
Totals	77811	44303	129876	76248	52232	43046	96868	110896	161509	32213	29512	17927	861231	

The above estimates were calculated according to the method described below from 316(b) p. 4.3-1.

> The total potential number of fish impinged per day was estimated by dividing the actual number of fish collected per month by the number of 24-hour sampling periods during the month. This number was then multiplied by the number of days in that particular month to obtain a monthly estimate. Data reduction for derivation of an estimate of potential monthly impingement involved the application of the following formula:
>
> $$I = \frac{NM}{H} \qquad (4.3.1)$$
>
> where
>
> I = potential number of organisms impinged on a monthly basis
> N = number of each category of organisms or species impinged during the monthly sampling effort
> M = number of days in the particular month of sampling effort
> H = number of 24-hour sampling periods during the monthly impingement sampling.

Detroit Edison's daily impingement data sheets from the Monroe plant were used to verify the estimates presented in Table 4.3-1 above. The analysis revealed that the extrapolations shown in Table 4.3-1 are major underestimates of impingement at the Monroe plant for the following reasons:

a) Separate estimates of the numbers of fish impinged per day (N/H in Equation 4.3.1 above) were apparently calculated for the test and the nontest screens, although this was not explained in the 316(b). These two estimates were then added together to calculate monthly impingement (I) for the plant as follows:

$$I = \left[(\Sigma C_t/H_t) + (\Sigma C_n/H_n)\right] \times M \qquad (1)$$

where I = number of fish impinged during month
ΣC_t = sum of fish counted from test screens
H_t = number of days fish were collected from test screens
ΣC_n = sum of fish counted from nontest screens
H_n = number of days fish were collected from nontest screens
M = number of days in month

Although Equation 4.3.1 is correct for calculating extrapolated monthly totals, Detroit Edison used the term N incorrectly for estimating impingement on the 14 nontest screens. In most cases, the term N for the nontest screens did not equal the total number of fish impinged on all the nontest screens but only the number of fish counted, although on most sampling days only the fish on the screens in Screenhouse 1 were counted (refer to Section II-A-3). The 316(b) estimates do not consider that the actual daily counts from the nontest screens usually represent impingement occurring in only a portion of the plant.

A frequency distribution of the number of circulating pumps operating on the days when impingement samples were collected (Fig. 3) indicates that almost 70% of the time the plant was operating at more than 50% capacity (more than six circulating pumps operating). Therefore, when fish were counted from only half of the intake screens and the term N was incorrectly used, as described above, impingement was seriously underestimated.

b) Notations by Detroit Edision on several of the impingement data sheets suggest that large numbers of young fish appearing in the impingement samples were at times not even counted (Table 1). The failure to count these small fish and to include them in the data base from which impingement was calculated further reduces the accuracy of the 316(b) impingement estimates shown in Table 4.3-1.

c) According to the daily impingement data sheets, the prototype fish collectors, located in front of the two test screens, were in operation during most of the 316(b) impingement sampling and were removing up to 95% of the fish from the test screenwells. Fish removed from the two test screenwells by the prototype fish collectors were prevented from being impinged and therefore were not used by Detroit Edison in calculating impingement for these two screenwells or for the entire plant. This practice is not explained in the 316(b) because, according to a Detroit Edison representative, the collectors were considered a permanent part of plant operation and only the screen counts were considered to represent true impingement. The exclusion of the fish pumped from the two test screenwells, from which the majority of the impingement data were obtained, contributes to a serious underestimate of impingement for the entire plant.

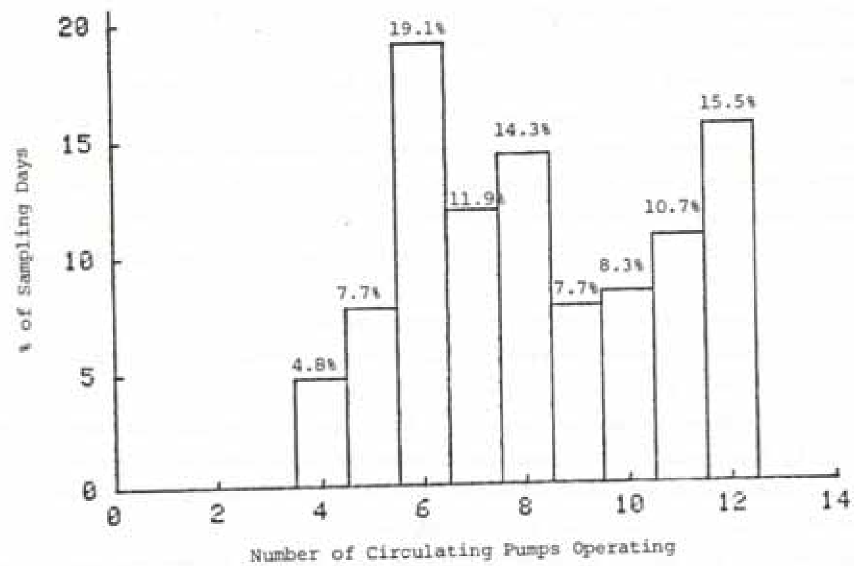
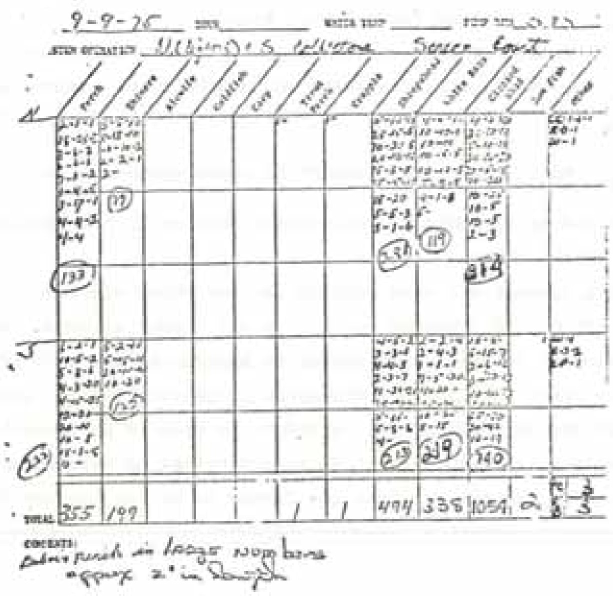


Figure 3. Number of circulating pumps operating on 168 days when impingement samples were collected during June 1975-May 1976. Derived from Detroit Edison's daily impingement data sheets.

Table 1. Detroit Edison daily impingement data sheets from the Monroe plant for July 22, 1975, and September 9, 1975, indicating large numbers of young fish in the test screenwells which were not included in the totals.

"Thousands of young of year fish"



"Baby perch in large numbers approx 2" in length"

Even without the major problems discussed above, the accuracy of the 316(b) estimates would be in doubt because of numerous discrepancies found on the daily impingement data sheets (refer to Appendix B). Most of these discrepancies are simple addition errors or errors that occurred when numbers were transposed from one column to another on the test screenwell tally sheets or transferred from the tally sheets to the daily impingement data sheets.

2. Alternative impingement estimates and statistical analysis

a. Calculation of estimates. We estimated daily impingement at the Monroe plant for 1975-76 by means of the following formula. For each sampling day, the formula corrects for the portion of the plant for which no data were collected and for the fish pumped out of the test screenwells by the prototype collectors.

$$\text{Daily estimate} = (C_t + C_p + C_n) \times (S_u/S_s) \times (P_p/P_s) \qquad (2)$$

where C_t = fish counted from test screens

C_p = fish pumped from test screenwells

C_n = fish counted from nontest screens

S_s = number of screens from which fish were collected

S_u = total number of screens in unit(s) whose screens were checked

P_s = number of circulating pumps operating in unit(s) whose screens were checked

P_p = total number of circulating pumps operating in entire plant

This yielded an estimate of impingement that could have occurred in the absence of the fish collectors.

Three assumptions were made to use the above equation:

a) Fish were impinged equally on all intake screens. The maximum water velocity in the intake system is apparently 120 cm/s (3.9 ft/s) in the secondary canal leading to Screenhouse 2 (Detroit Edison, undated). The potential for impingement may therefore be greater in Screenhouse 2 than in Screenhouse 1. If impingement is indeed higher in Screenhouse 2, impingement estimates for the entire plant are likely to be low because they are based primarily on data from Screenhouse 1. Data with which impingement in Screenhouse 2 could be related to that in Screenhouse 1 are available for only 5 days during 1 month of the year (Section II-A-3) and are not sufficient for a reliable comparison.

b) All fish pumped from the test screenwells would have been impinged.

c) No fish were impinged by a circulating pump that was not operating. On 3 sampling days during the year, fish were collected from the intake screens when no circulating pumps were operating. This impingement could have been due to operation of the general service pumps, but, because each pump has a capacity of only 11 cfs, the pumps were not considered in the calculation, and the 3 sampling days were excluded from the analysis.

The manner in which Equation 2 was used to calculate daily impingement estimates can be demonstrated by using the data for gizzard shad collected by Detroit Edison in August 1975 (Table 2). The estimate for August 1 is:

$$(360 + 0 + 1938) \times (4/2) \times (12/3) = 18{,}384$$

Estimates for the other 10 sampling days were similarly calculated.

Monthly estimates were calculated from the daily estimates for each species according to the equation below:

$$\text{Number impinged each month} = \frac{\text{Sum of daily impingement estimates each month}}{\text{Number of sample days each month}} \times \text{Number of days in month} \quad (3)$$

Using Equation 3 and the data in Table 2, the August estimate for gizzard shad impingement therefore is:

$$(148{,}583.4/11) \times 31 = 418{,}735$$

This is approximately eight times the 316(b) estimate of 49,814 (Table 4.3-1) which was calculated by Equation 1 as follows:

$$\left[(7708/9) + (1501/2)\right] \times 31 = 49{,}814$$

Table 2. Data base used in comparison of 316(b) and alternative methodologies for estimating gizzard shad impingement, August 1975. Detroit Edison daily impingement data sheets on which counts are recorded are presented in Appendix C.

Sampling date	Number of shad counted on screens		Number of shad pumped from test screenwells	Number of screens sampled	Number of screens in unit(s) sampled	Number of pumps sampled	Number of pumps operating in plant
	Test screens (C_t)	Nontest screens (C_n)	(C_p)	(S_s)	(S_u)	(P_s)	(P_p)
August 1	360	-	1938	2	4	3	12
5	1671	-	2611	2	4	3	12
6	328	-	1621	2	4	3	11
7	244	-	287	2	4	3	11
8	1458	-	1764	2	4	3	11
14	-	836*	-	8	8	6	10
21	-	665	-	8	8	6	12
26	1062	-	1132	2	4	3	12
27	1311	-	483	2	4	3	12
28	900	-	323	2	4	3	12
29	374	-	849	2	4	3	12

*Note error on data sheet; total should be 796.

The annual impingement estimate for all species combined, shown in Table 3, is approximately 4.7 million fish, which is considerably higher than the 861,000 fish estimated in the 316(b).[1/] The species composition shown in Table 3 (52% gizzard shad, 18% shiners, 13% yellow perch, 7% white bass, and 6% freshwater drum) is about the same as that shown in 316(b) Table 4.3-1.

NOTE

> Estimates in figures and tables are based on Detroit Edison's impingement and entrainment data and are subject to the questions raised in the present report concerning the sampling methods.

b. Precision of impingement estimates. The monthly impingement estimates and associated 95% confidence intervals presented in Table 3 are illustrated in Figure 4 for all species combined and in Figures 5-9 for each of the five most commonly impinged species (gizzard shad, shiners, yellow perch, white bass, and freshwater drum).[2/] As shown in Figure 4 and Table 3, the sampling error (at P = 0.05 significance level) for each

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[1/] In most cases, the daily impingement estimates could be normalized by a $\log_{10}(x + 1)$ transformation (refer to Appendix D). Because, however, the 316(b) estimates were based only on the untransformed arithmetic data, our estimates are also based on the untransformed counts for comparison. [Impingement estimates based on the $\log_{10}(x + 1)$ transformation are presented in Appendix E; the transformation reduces the annual estimate by approximately 40%.]

[2/] The confidence interval is the interval of values on either side of the estimate which is expected to include the true population value (v). The 95% confidence interval (95% CI) defines the interval which, from repeated samples, will include the population value 95 times out of 100 and equals $v \pm ts_v$, where t is Student's t-statistic and s_v is standard error. The absolute value of ts_v can also be referred to as sampling error and defines the precision of the estimate; the smaller the sampling error, the better the estimate.

Table 3. Estimates of impingement at the Monroe Power Plant for June 1975-May 1976, calculated from Detroit Edison's daily impingement data sheets. S.E. = standard error, S_v; C.I. = absolute value of ts_v.

	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	TOTALS	TOTAL
NO. OF SAMPLE DAYS	10	15	11	15	14	14	13	14	12	16	18	16		
LAMPREY	33	0	0	4	0	19	14	4	0	23	27	5	129	<0.1
S.E.	33.	0.	0.	4.	0.	19.	14.	4.	0.	23.	19.	3.	51.	
.95 C.I.	75.	0.	0.	9.	0.	42.	31.	10.	0.	50.	40.	7.	102.	
.90 C.I.	60.	0.	0.	7.	0.	34.	25.	8.	0.	41.	33.	6.	85.	
LONGNOSE GAR	0	0	0	11	81	30	14	0	0	26	20	3	185	<0.1
S.E.	0.	0.	0.	8.	36.	20.	14.	0.	0.	15.	11.	3.	46.	
.95 C.I.	0.	0.	0.	16.	78.	43.	31.	0.	0.	33.	22.	7.	96.	
.90 C.I.	0.	0.	0.	13.	64.	35.	25.	0.	0.	27.	18.	6.	80.	
BOWFIN	7	0	0	4	0	0	0	0	0	0	7	0	18	<0.1
S.E.	7.	0.	0.	4.	0.	0.	0.	0.	0.	0.	7.	0.	10.	
.95 C.I.	15.	0.	0.	9.	0.	0.	0.	0.	0.	0.	14.	0.	20.	
.90 C.I.	12.	0.	0.	7.	0.	0.	0.	0.	0.	0.	12.	0.	17.	
ALEWIFE	2790	290	132	84	1271	1979	40	16	0	1270	1891	5798	15521	0.3
S.E.	515.	98.	69.	45.	653.	569.	20.	16.	0.	376.	476.	2515.	2779.	
.95 C.I.	1165.	210.	154.	96.	1411.	1229.	61.	33.	0.	801.	1004.	5354.	5561.	
.90 C.I.	944.	172.	126.	79.	1157.	1008.	50.	27.	0.	659.	828.	4408.	4647.	
GIZZARD SHAD	453	441403	418735	113288	37350	245045	351936	171934	521500	107775	30461	6648	2446528	52.2
S.E.	197.	152130.	93057.	27473.	8503.	98610.	96102.	49277.	212072.	17763.	6032.	1445.	315193.	
.95 C.I.	445.	326319.	207330.	58931.	18367.	212997.	209406.	106538.	466770.	37953.	12728.	3079.	639704.	
.90 C.I.	360.	267901.	168618.	48381.	15059.	174638.	171254.	87270.	380881.	31138.	10496.	2533.	527002.	
COHO SALMON	48	0	0	0	0	0	0	0	0	0	0	0	48	<0.1
S.E.	48.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	48.	
.95 C.I.	109.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	96.	
.90 C.I.	88.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	80.	
CHINOOK SALMON	33	0	0	0	16	4	7	0	0	2	0	0	52	<0.1
S.E.	33.	0.	0.	0.	16.	4.	7.	0.	0.	2.	0.	0.	37.	
.95 C.I.	75.	0.	0.	0.	33.	9.	16.	0.	0.	4.	0.	0.	75.	
.90 C.I.	60.	0.	0.	0.	27.	8.	13.	0.	0.	3.	0.	0.	63.	
SMELT	218	262	43	85	12800	11933	1957	328	694	8	319	753	29400	0.6
S.E.	89.	119.	29.	40.	5990.	3237.	609.	79.	257.	8.	64.	153.	6652.	
.95 C.I.	201.	255.	65.	103.	12956.	6992.	1327.	170.	565.	17.	136.	327.	13711.	
.90 C.I.	163.	210.	53.	84.	10673.	5733.	1085.	139.	461.	14.	112.	269.	11457.	
NORTHERN PIKE	48	8	0	32	40	4	39	8	41	14	32	15	281	<0.1
S.E.	35.	6.	0.	22.	35.	4.	32.	8.	39.	10.	18.	10.	76.	
.95 C.I.	78.	12.	0.	47.	76.	8.	70.	17.	85.	22.	38.	21.	156.	
.90 C.I.	64.	10.	0.	38.	63.	7.	57.	14.	69.	18.	32.	17.	130.	
MUSKELLUNGE	30	40	0	9	0	3	7	0	0	0	0	0	89	<0.1
S.E.	30.	20.	0.	6.	0.	3.	7.	0.	0.	0.	0.	0.	38.	
.95 C.I.	68.	43.	0.	14.	0.	7.	16.	0.	0.	0.	0.	0.	75.	
.90 C.I.	55.	36.	0.	11.	0.	6.	13.	0.	0.	0.	0.	0.	63.	

GOLDFISH		339	565	396	538	275	238	2557	1443	5305	5748	1578	264	19244	0.4
	S.E.	83.	203.	100.	130.	100.	55.	425.	363.	2881.	1100.	483.	64.	3186.	
	.95 C.I.	188.	436.	222.	280.	216.	120.	927.	784.	6342.	2344.	1019.	137.	6375.	
	.90 C.I.	153.	358.	181.	230.	177.	98.	758.	643.	5175.	1928.	840.	113.	5327.	
CARP		0	51	23	217	3	9	198	58	881	436	17	3	1896	<0.1
	S.E.	0.	33.	23.	123.	3.	6.	92.	28.	381.	108.	11.	3.	428.	
	.95 C.I.	0.	71.	50.	264.	7.	13.	200.	60.	839.	229.	22.	6.	855.	
	.90 C.I.	0.	59.	41.	216.	5.	10.	163.	49.	685.	188.	18.	5.	715.	
SHINER		88587	134137	154870	60063	66642	42653	54124	21492	54748	55080	70132	57951	861279	18.4
	S.E.	18014.	34728.	75863.	10588.	13623.	9572.	13463.	3508.	15967.	15972.	14325.	18552.	94489.	
	.95 C.I.	40748.	74492.	169023.	22711.	29427.	20677.	29335.	7577.	35143.	34036.	30226.	39534.	189072.	
	.90 C.I.	33020.	61156.	137464.	18645.	24127.	16953.	23990.	6213.	28677.	27999.	24926.	32521.	157985.	
WHITE SUCKER		41	25	43	85	49	25	21	4	5	35	18	18	368	<0.1
	S.E.	33.	17.	29.	65.	35.	19.	15.	4.	5.	19.	17.	10.	95.	
	.95 C.I.	75.	36.	65.	139.	75.	42.	34.	10.	12.	40.	35.	21.	190.	
	.90 C.I.	61.	30.	53.	114.	61.	34.	28.	8.	10.	33.	29.	17.	158.	
BLACK BULLHEAD		0	0	0	0	18	0	0	0	0	0	0	0	18	<0.1
	S.E.	0.	0.	0.	0.	18.	0.	0.	0.	0.	0.	0.	0.	18.	
	.95 C.I.	0.	0.	0.	0.	38.	0.	0.	0.	0.	0.	0.	0.	35.	
	.90 C.I.	0.	0.	0.	0.	31.	0.	0.	0.	0.	0.	0.	0.	30.	
YELLOW BULLHEAD		13	20	0	66	21	4	64	102	271	254	136	48	999	<0.1
	S.E.	13.	17.	0.	34.	18.	4.	29.	46.	105.	66.	54.	21.	153.	
	.95 C.I.	30.	36.	0.	74.	38.	9.	62.	99.	230.	141.	113.	45.	307.	
	.90 C.I.	24.	29.	0.	61.	31.	8.	51.	81.	188.	116.	94.	37.	256.	
BROWN BULLHEAD		45	4	0	0	0	0	14	13	0	0	10	10	96	<0.1
	S.E.	26.	4.	0.	0.	0.	0.	14.	13.	0.	0.	10.	10.	36.	
	.95 C.I.	59.	9.	0.	0.	0.	0.	31.	29.	0.	0.	21.	21.	71.	
	.90 C.I.	48.	7.	0.	0.	0.	0.	25.	24.	0.	0.	17.	17.	59.	
CHANNEL CATFISH		56	164	194	975	91	145	1193	245	670	128	131	39	4031	0.1
	S.E.	38.	44.	56.	304.	28.	65.	563.	42.	230.	41.	38.	20.	692.	
	.95 C.I.	85.	95.	124.	653.	61.	140.	1227.	90.	506.	88.	80.	43.	1385.	
	.90 C.I.	69.	78.	101.	536.	50.	115.	1003.	74.	413.	72.	66.	35.	1157.	
TROUT-PERCH		7401	898	1013	313	347	176	172	2077	3153	7097	7996	213	30056	0.7
	S.E.	2293.	230.	577.	77.	113.	59.	118.	560.	707.	2102.	2282.	58.	4015.	
	.95 C.I.	5108.	493.	1287.	164.	245.	127.	256.	1210.	1557.	4479.	4815.	123.	8035.	
	.90 C.I.	4204.	405.	1046.	135.	201.	104.	210.	992.	1271.	3684.	3970.	101.	6714.	
WHITE BASS		658	130330	123329	72019	6872	1603	1616	318	259	235	264	184	337687	7.2
	S.E.	229.	41749.	23530.	13494.	1855.	336.	346.	114.	70.	88.	62.	36.	49825.	
	.95 C.I.	519.	89551.	52425.	28946.	4006.	725.	754.	247.	154.	187.	131.	77.	99697.	
	.90 C.I.	421.	73520.	42637.	23764.	3284.	595.	617.	202.	126.	154.	108.	63.	83307.	
ROCK BASS		473	178	348	262	58	23	72	0	82	333	151	111	2091	<0.1
	S.E.	240.	74.	127.	88.	27.	13.	58.	0.	41.	110.	24.	34.	332.	
	.95 C.I.	560.	158.	284.	188.	57.	29.	126.	0.	89.	234.	50.	73.	664.	
	.90 C.I.	454.	130.	231.	154.	47.	23.	103.	0.	73.	192.	41.	60.	555.	
SUNFISH		342	341	207	478	366	313	953	269	245	267	108	90	4057	0.1
	S.E.	117.	101.	109.	138.	105.	85.	135.	93.	83.	56.	37.	26.	335.	
	.95 C.I.	265.	216.	244.	297.	226.	184.	295.	201.	184.	119.	77.	55.	671.	
	.90 C.I.	215.	177.	198.	244.	185.	151.	241.	165.	150.	98.	64.	45.	560.	

SMALL-MOUTH BASS	132	0	21	14	73	139	0	49	0	0	2	6	436	<0.1
S.E.	132.	0.	21.	8.	39.	76.	0.	37.	0.	0.	2.	4.	163.	
.95 C.I.	299.	0.	46.	17.	85.	165.	0.	80.	0.	0.	4.	9.	327.	
.90 C.I.	242.	0.	37.	14.	70.	135.	0.	65.	0.	0.	4.	7.	273.	
LARGE-MOUTH BASS	33	0	21	0	3	4	72	0	0	4	0	18	155	<0.1
S.E.	33.	0.	21.	0.	3.	4.	58.	0.	0.	4.	0.	10.	71.	
.95 C.I.	75.	0.	46.	0.	7.	8.	126.	0.	0.	8.	0.	22.	142.	
.90 C.I.	60.	0.	37.	0.	5.	7.	103.	0.	0.	7.	0.	18.	118.	
WHITE CRAPPIE	14	52	209	237	108	41	318	79	86	4	117	36	1379	<0.1
S.E.	9.	36.	141.	82.	40.	17.	100.	43.	43.	4.	45.	13.	214.	
.95 C.I.	21.	77.	313.	176.	86.	36.	218.	93.	95.	8.	94.	27.	428.	
.90 C.I.	17.	63.	255.	145.	71.	29.	178.	76.	77.	7.	77.	22.	357.	
YELLOW PERCH	171671	124179	183364	63807	13647	6616	4898	10051	21169	2971	17073	1134	625580	13.3
S.E.	52168.	41498.	48507.	13888.	1952.	1388.	2210.	2617.	8355.	2732.	4560.	180.	84268.	
.95 C.I.	118094.	89013.	100063.	29790.	4216.	2998.	4815.	5654.	18390.	5821.	9621.	383.	168551.	
.90 C.I.	95624.	73078.	87886.	24457.	3457.	2458.	3938.	4636.	15006.	4788.	7934.	315.	140930.	
WALLEYE	0	3279	3746	566	135	138	48	0	186	50	127	39	8316	0.2
S.E.	0.	1015.	1028.	132.	71.	135.	35.	0.	57.	28.	45.	15.	1461.	
.95 C.I.	0.	2177.	2289.	284.	154.	291.	77.	0.	125.	59.	94.	32.	2923.	
.90 C.I.	0.	1787.	1862.	233.	126.	239.	63.	0.	102.	48.	78.	26.	2443.	
LOGPERCH	1670	1009	1935	657	935	889	118	51	0	36	355	341	7996	0.2
S.E.	564.	265.	570.	222.	163.	189.	67.	22.	0.	14.	73.	81.	917.	
.95 C.I.	1275.	569.	1270.	475.	357.	400.	146.	47.	0.	30.	154.	174.	1836.	
.90 C.I.	1033.	467.	1033.	390.	289.	334.	120.	39.	0.	25.	127.	143.	1534.	
FRESHWATER DRUM	22180	19278	100229	94864	20912	10175	9288	1082	1277	693	1356	1418	290752	6.2
S.E.	6426.	4273.	26306.	20142.	3782.	4628.	1844.	173.	327.	165.	182.	233.	34564.	
.95 C.I.	14535.	9058.	58611.	43204.	8169.	9996.	4018.	373.	719.	352.	394.	497.	69207.	
.90 C.I.	11779.	7436.	47667.	35470.	6698.	8195.	3286.	306.	586.	290.	316.	409.	57028.	
TOTALS	297315	856471	997018	409478	162113	322207	429740	209623	610572	187489	132328	75145	4689499	
S.E.	55618.	166835.	134219.	40593.	17774.	99246.	97089.	49476.	212858.	24164.	16374.	18781.	345170.	
.95 C.I.	125808.	357860.	299039.	87072.	38393.	214372.	211556.	106868.	468500.	51494.	34550.	40022.	690686.	
.90 C.I.	100780.	292461.	241037.	71160.	31301.	174773.	171944.	87127.	379312.	42191.	28395.	32791.	577125.	

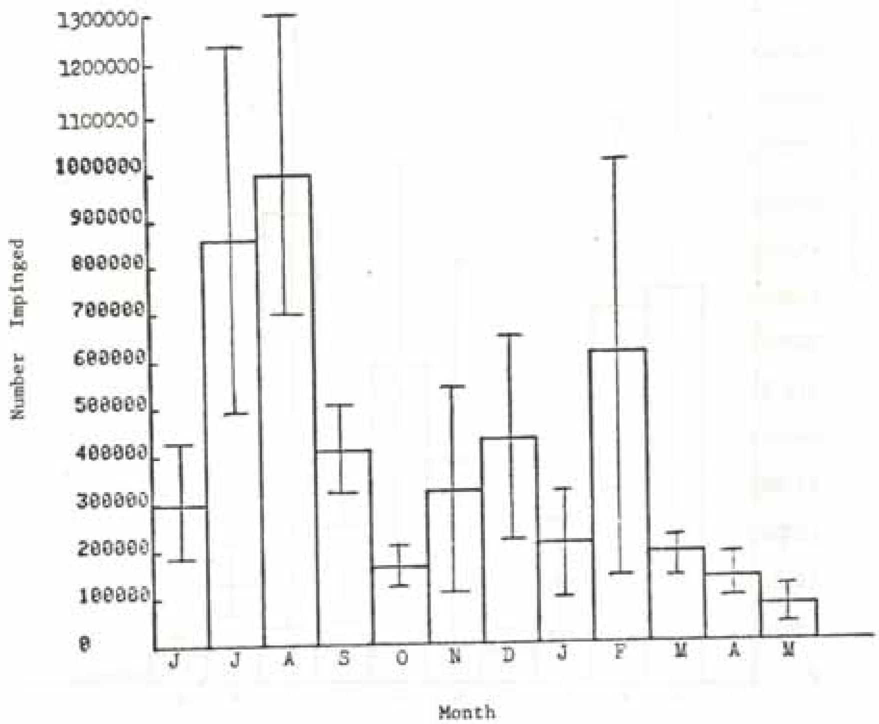

Figure 4. Impingement by month for all species combined (June 1975-May 1976), showing 95% confidence intervals.

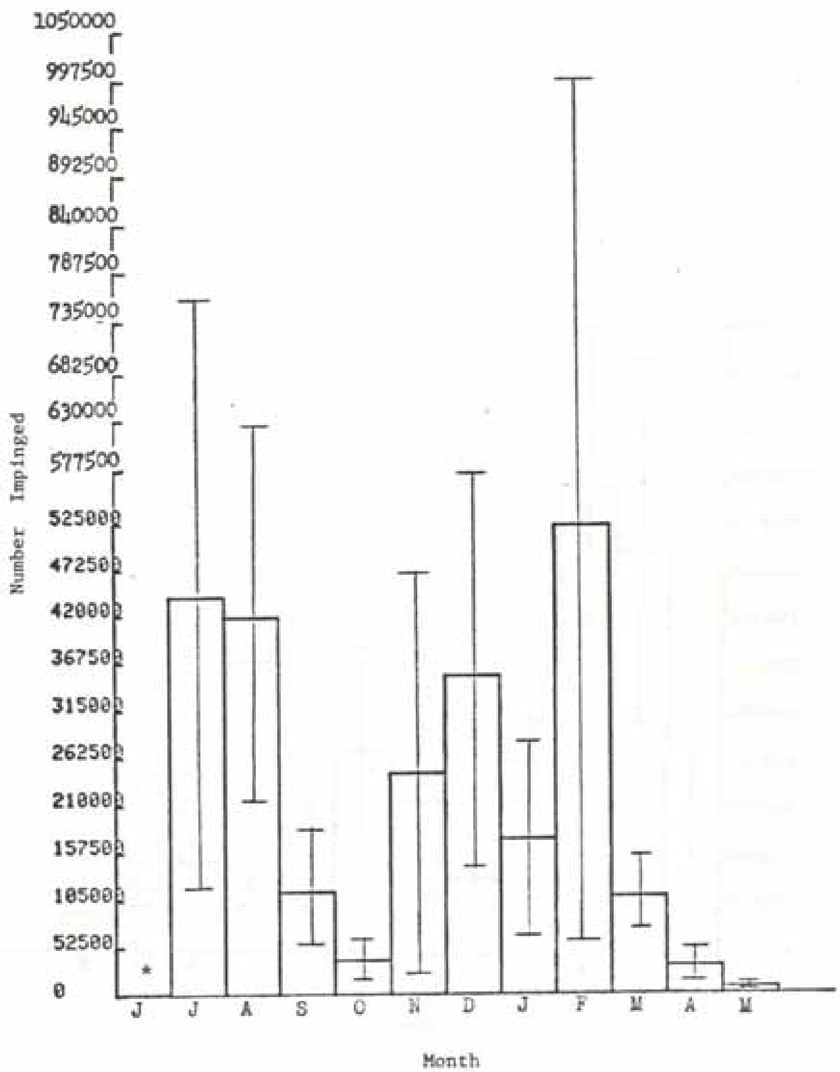

Figure 5. Impingement by month for gizzard shad (June 1975-May 1976), showing 95% confidence intervals. * = <500.

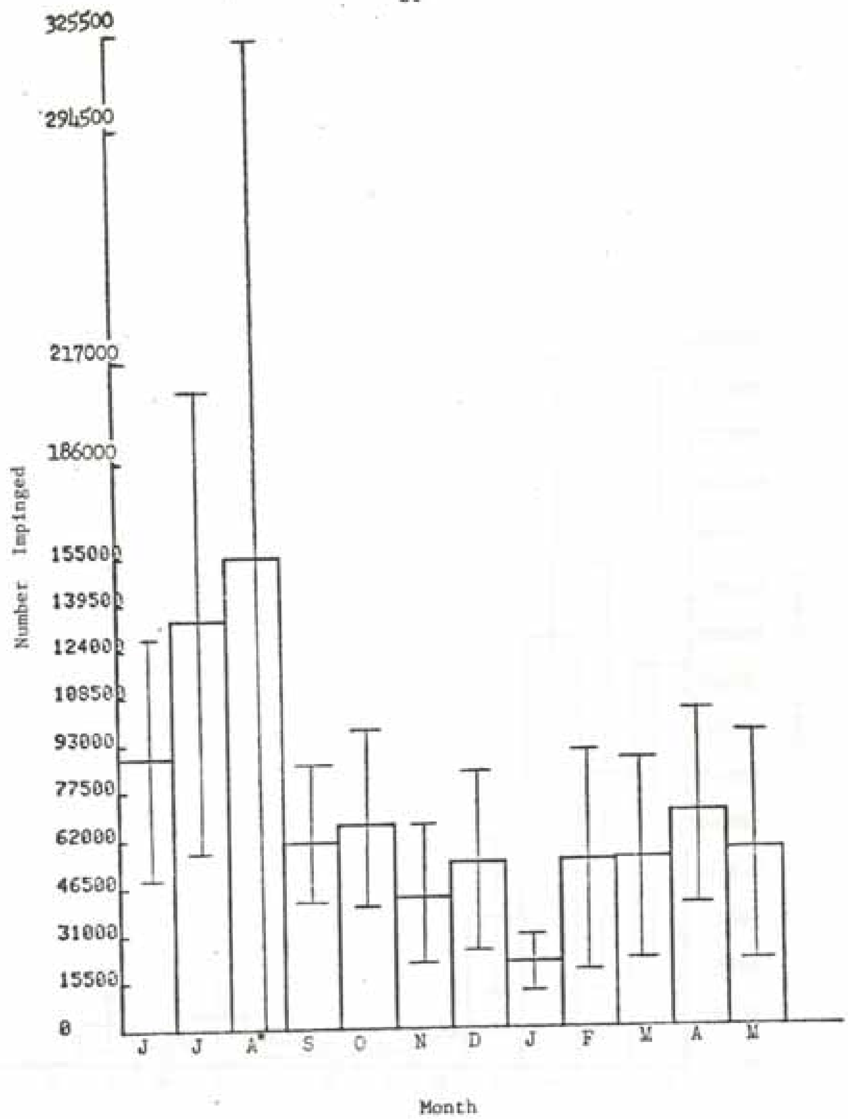

Figure 6. Impingement by month for shiners (June 1975-May 1976), showing 95% confidence intervals. *The sampling error for the August estimate is 109% of the estimate and the CI includes zero.

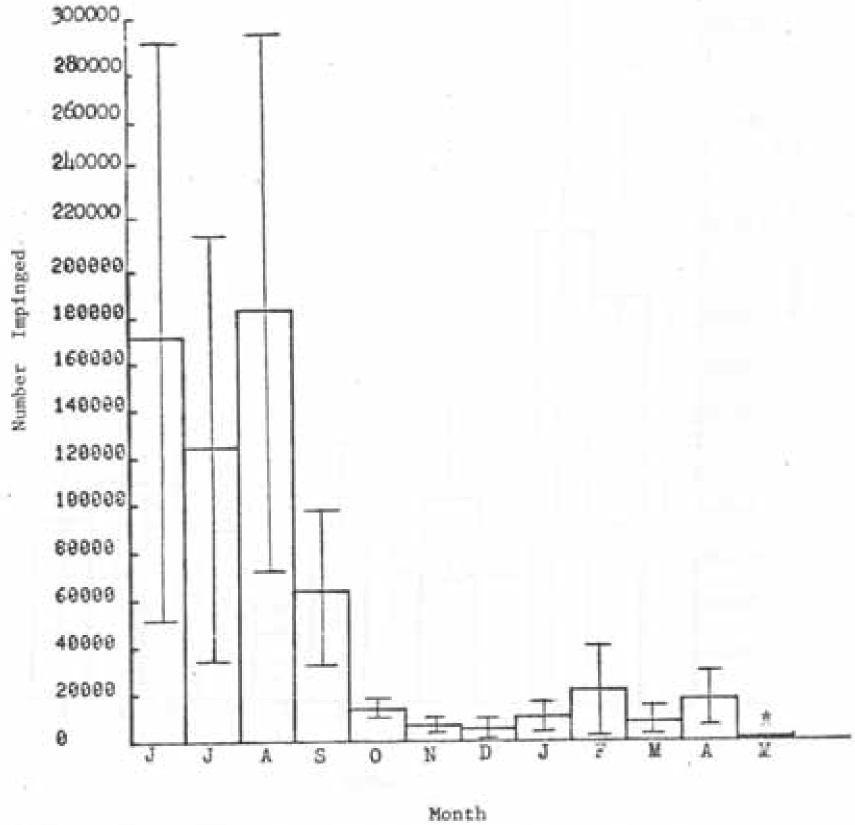

Figure 7. Impingement by month for yellow perch (June 1975-May 1976), showing 95% confidence intervals. * = <1500.

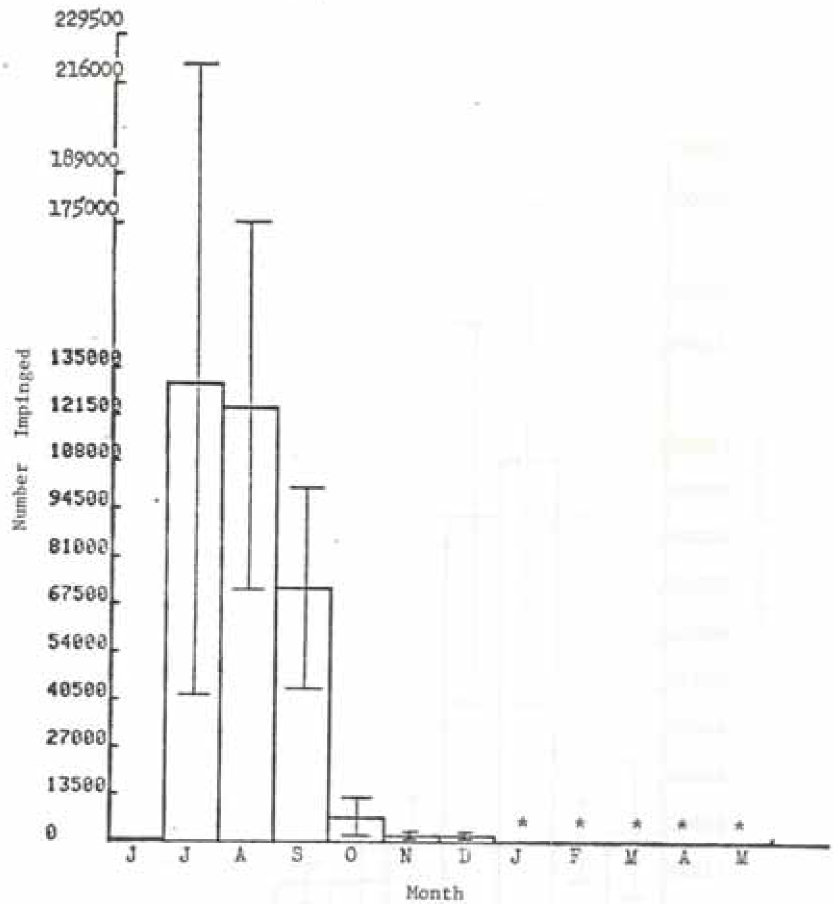

Figure 8. Impingement by month for white bass (June 1975-May 1976), showing 95% confidence intervals. * = <500.

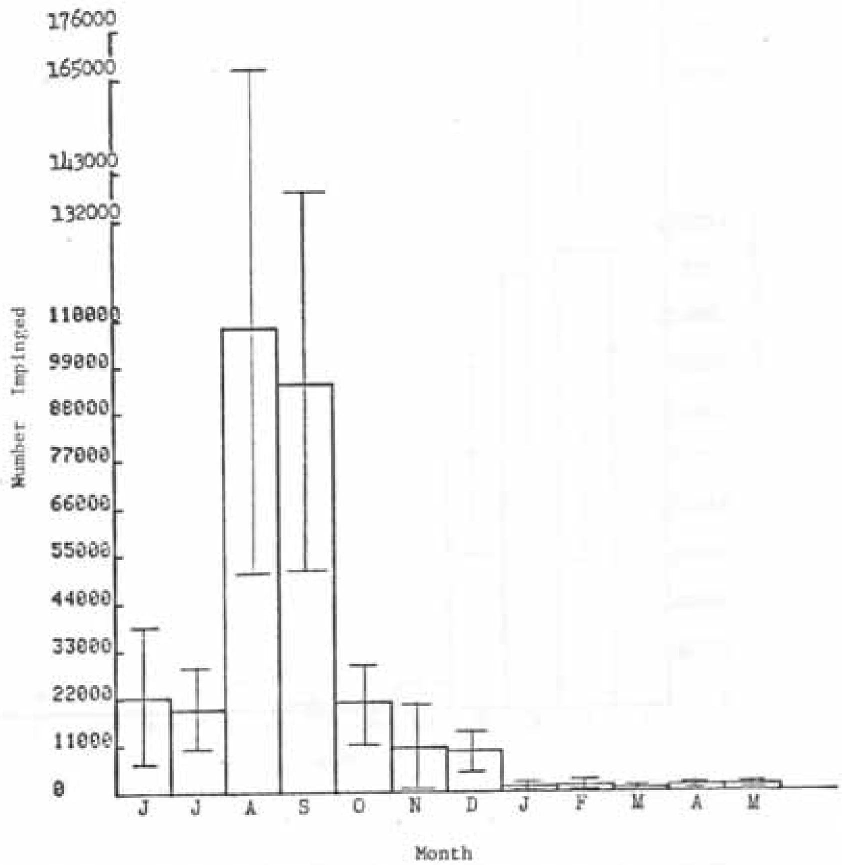

Figure 9. Impingement by month for freshwater drum (June 1975-May 1976), showing 95% confidence intervals.

of the monthly impingement estimates for all species combined is approximately 50% or less of the estimate, except for November (67%) and February (77%). The sampling error is 15% of the annual estimate (Table 4). The sampling errors for the annual estimates of the commonly impinged species (Table 4) are also relatively small (26% for gizzard shad, 22% for shiners, 27% for yellow perch, 30% for white bass, and 24% for drum); however, the sampling errors for the monthly estimates are at times quite large (109% for shiners in August and 98% for yellow perch in December; Table 3, Figures 6 and 7).

For infrequently impinged species such as coho and chinook salmon, the sampling errors are greater than 100% of the annual estimates and include zero (Table 4); thus, based on the data as obtained by Detroit Edison, the numbers of these species impinged are not significantly different from zero. However, we do not believe that impingement of these species has been adequately estimated because of the limitations of the sampling methods (see Section II-A).

c. Correlation of impingement estimates with intake temperatures and flow. Based on 316(b) Figure 4.3-1 (below), Detroit Edison states that "there does not appear to be a strong correlation between the total numbers of fish impinged and the intake water flows or intake water temperatures" (p. 4.3-6).

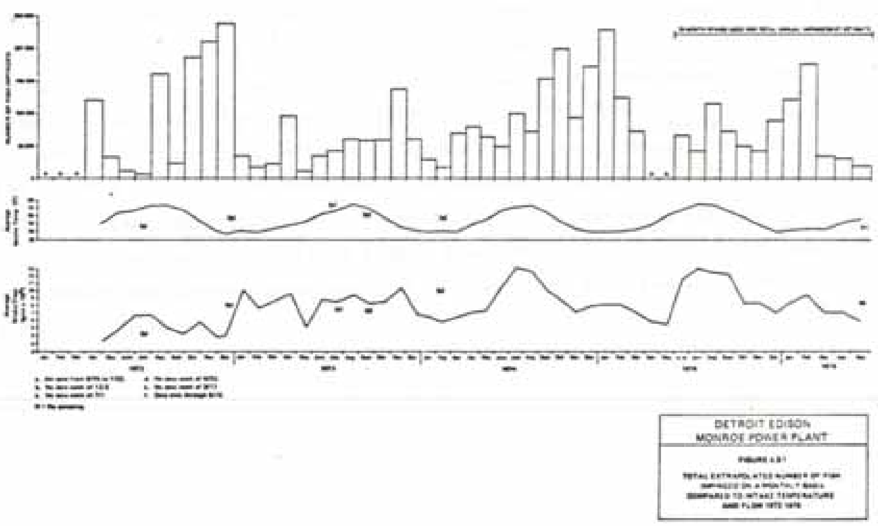

Table 5. Correlation matrices for daily impingement estimates [transformed by $\log_{10}(x + 1)$] vs. intake temperature and intake flow components. DEST = daily impingement estimate, IFLOW = intake flow, TEMP = intake temperature, RFLOW = river flow, LKCOMP = lake component of intake flow.

CORRELATE SYSTRAT4 V=1,2-5 L=.05,.01 ST=SPEC 30,100,506,801,155,154
CASES=ALL

CORRELATION MATRIX 1 ALL SPECIES

N= 168 DF= 166 R .0500= .1515 R .0100= .1982

VARIABLE					
1.DEST	1.0000				
2.IFLOW	.5439	1.0000			
3.TEMP	.2031	.6841	1.0000		
4.RFLOW	.0367	-.2097	-.4650	1.0000	
5.LKCOMP	.2143	.6469	.6933	-.8813	1.0000
	1. DEST	2. IFLOW	3. TEMP	4. RFLOW	5. LKCOMP

CORRELATION MATRIX 2 GIZZARD SHAD

N= 168 DF= 166 R .0500= .1515 R .0100= .1982

VARIABLE					
1.DEST	1.0000				
2.IFLOW	.0752	1.0000			
3.TEMP	-.2842	.6841	1.0000		
4.RFLOW	.1642	-.2097	-.4650	1.0000	
5.LKCOMP	-.0933	.6469	.6933	-.8813	1.0000
	1. DEST	2. IFLOW	3. TEMP	4. RFLOW	5. LKCOMP

CORRELATION MATRIX 3 [illegible]

N= 168 DF= 166 R .0500= .1515 R .0100= .1982

VARIABLE					
1.DEST	1.0000				
2.IFLOW	.3815	1.0000			
3.TEMP	.4300	.6841	1.0000		
4.RFLOW	-.3356	-.2097	-.4650	1.0000	
5.LKCOMP	.4463	.6469	.6933	-.8813	1.0000
	1. DEST	2. IFLOW	3. TEMP	4. RFLOW	5. LKCOMP

CORRELATION MATRIX 4 YELLOW PERCH

N= 168 DF= 166 R .0500= .1515 R .0100= .1982

VARIABLE					
1.DEST	1.0000				
2.IFLOW	.7473	1.0000			
3.TEMP	.6819	.6841	1.0000		
4.RFLOW	-.5069	-.2097	-.4650	1.0000	
5.LKCOMP	.7566	.6469	.6933	-.8813	1.0000
	1. DEST	2. IFLOW	3. TEMP	4. RFLOW	5. LKCOMP

CORRELATION MATRIX 5 WHITE BASS

N= 168 DF= 166 R .0500= .1515 R .0100= .1982

VARIABLE					
1.DEST	1.0000				
2.IFLOW	.6232	1.0000			
3.TEMP	.6124	.6841	1.0000		
4.RFLOW	-.3546	-.2097	-.4650	1.0000	
5.LKCOMP	.5622	.6469	.6933	-.8813	1.0000
	1. DEST	2. IFLOW	3. TEMP	4. RFLOW	5. LKCOMP

CORRELATION MATRIX 6 FRESHWATER DRUM

N= 168 DF= 166 R .0500= .1515 R .0100= .1982

VARIABLE					
1.DEST	1.0000				
2.IFLOW	.6328	1.0000			
3.TEMP	.6613	.6841	1.0000		
4.RFLOW	-.4996	-.2097	-.4650	1.0000	
5.LKCOMP	.6955	.6469	.6933	-.8813	1.0000
	1. DEST	2. IFLOW	3. TEMP	4. RFLOW	5. LKCOMP

The 316(b) does not discuss the effects on impingement of this deliberate recirculation, which returned up to 20% of the plant discharge directly to the river during the winter to prevent icing of the intake screens. However, according to Detroit Edison representatives, the recirculation of heated effluent was discontinued because gizzard shad were being impinged in such large numbers when this practice was employed during the winter that operation of the plant was being impeded.

The 316(b) also does not consider the effects on impingement of the unintentional recirculation of plant effluent (from the discharge canal back to the plant intake via Lake Erie). The effects of residual chlorine in the discharge or of supersaturation of the discharge waters during the winter could increase the vulnerability of fish in the intake area to impingement.

3. Length and age of impinged fish

The 316(b) data base does not contain the information on the lengths and ages of the impinged fish required for a description of the segment of the population impinged, an assessment of the sampling methods, and an evaluation of the impact of impingement losses. According to the impingement sampling methods described on p. 6 of this report, "representative specimens" from the collection basket were measured and weighed, but these data are not presented in the 316(b). Instead, only general statements are made, such as the following examples from p. 4.3-4 of the 316(b):

> . . . In general, the majority of rainbow smelt impinged during the spring and summer were young-of-the-year (5-8 cm).

> . . . Goldfish impinged during the late winter and early spring were generally large adults (30 cm or longer) or smaller juveniles (5 to 10 cm).

A few length data (for 7-14 individuals each month) were included with the monthly impingement summary sheets. According to a representative of Detroit Edison, the fish from which these data were taken were collected primarily to determine their state of sexual maturity. We did not find any length information for fish collected from the nontest screens. Some measurements were recorded by Detroit Edison on length data sheets for fish pumped from the test screenwells, but sufficient data with which to formulate even provisional length-frequency distributions are available only for yellow perch (458 length measurements for June 1975-May 1976). According to a Detroit Edison representative, these perch were selected randomly from the holding pool into which fish from the test screenwells were pumped and these were the only length measurements taken during the year. The length-frequency distribution for these yellow perch (Fig. 10) shows that 51% were in the 7-8 in. (18-20 cm) range. This does not agree with the statement on p. 4.3-5 of the 316(b) that:

> . . . In general, small young-of-the-year yellow perch (5 to 8 cm) were collected during the warm summer months, while those impinged during the spring were small adults (15 to 20 cm).

The data available to us do not demonstrate such a seasonal difference. Only one of the 458 perch represented in Figure 10 was in the 5-8 cm range, and this fish was collected in May. The mean length of measured perch from the holding pool was in the 16-20 cm range for every month. The absence of length-frequency data for perch just large enough to be retained on the 3/8-in. mesh screens indicates that few of these were measured despite the fact that Table 1 suggests that many were impinged.

No evidence was found in the 316(b) that any fish were aged according to the scale method. Consequently, we assigned ages to the yellow perch in Figure 10 on the basis of the following age-length relation for Lake Erie yellow perch obtained from W. L. Hartman (personal communication); Hartman, Van Meter, Wolfert, and Busch (1974); and Hartman, Nepszy, and Scholl (1977):

YOY = ≤3.9 in. (approximately 10 cm)

Yearlings = 4.0-6.9 in. (approximately 10-17.9 cm)

Adults = ≥7 in. (approximately 18 cm)

Thus, according to our calculations, the perch represented in Figure 10 were <1% young-of-the-year (YOY), 29% yearlings, and 70% older individuals.

4. Biomass estimate of impinged fish

The 316(b) presents no estimate of the biomass of fish impinged at the Monroe plant, and, because Detroit Edison did not collect sufficient

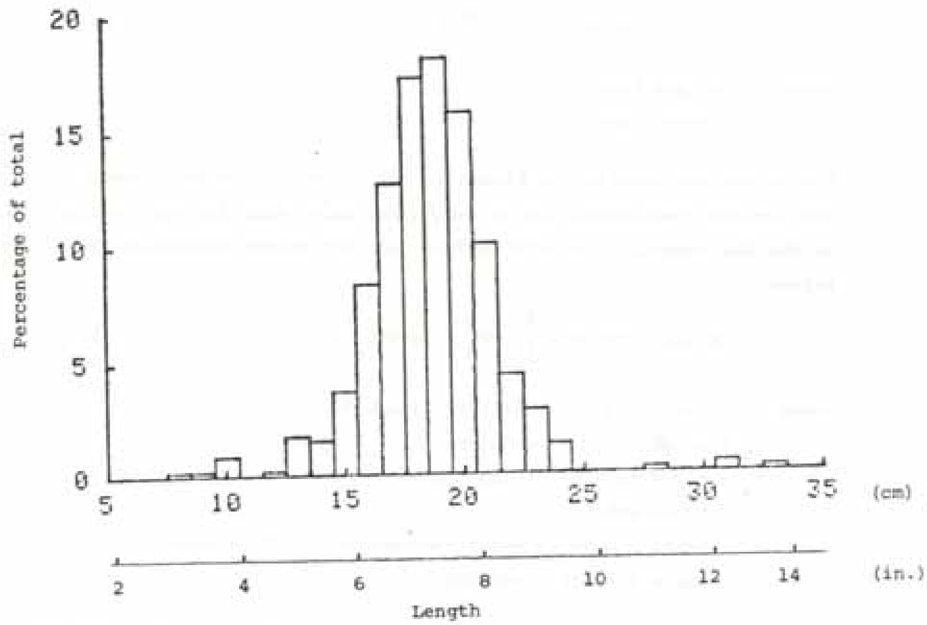

Figure 10. Length-frequency distribution of yellow perch. This distribution is based on measurements from Detroit Edison's length data sheets for fish pumped from the two test screenwells at the Monroe Power Plant (June 1975-May 1976).

weight or length data for all species of fish in their impingement samples, we cannot estimate the total biomass of fish that were impinged.

We were, however, able to develop an estimate of the biomass of yellow perch impinged using the length-frequency data presented in Figure 10 and the following length-weight relationship (Lake Erie Committee on Yellow Perch, 1976)[3/]:

$$W = 0.3729 \times 10^{-2} L^{3.2826} \quad (4)$$

where W = weight (oz)

L = length (in)

The length distribution in Figure 10 was assumed to be representative of the impinged population, and a weight was calculated for each length class in the distribution. A total biomass was determined according to the equation below:

$$\text{Perch Biomass} = \sum_{L=3}^{13} [W_L \times (N \times \%_L)] \quad (5)$$

where L = length of perch (in) in Figure 10

W_L = weight of an average perch of length L

$\%_L$ = percentage of impinged perch composed of individuals of length L

N = total number of perch impinged = 625,580 (refer to Table 3 of this report)

The estimate of the annual biomass of impinged yellow perch is 108,992 lb, with a 95% CI of 79,607-138,377 lb. This estimate, however, is based solely on Detroit Edison's measurements recorded on the length data sheets, which

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[3/] The weights recorded on Detroit Edison's length data sheets could not be used because they were usually reported for groups of 10 fish (regardless of their lengths), instead of for individual fish, and because we do not know that these groups were representative of the impinged population.

we believe are biased toward the larger fish as discussed in Section II-B-3. The biomass estimate might therefore be high.

C. Evaluation of 316(b) Impact Analysis

1. Verification of trawl data used in the 316(b) for population estimates

The trawl data presented in 316(b) Tables 4.2-8 through 4.2-16 were taken directly by Detroit Edison from three sources: 1) an Ohio Department of Natural Resources (ODNR) report (Van Vooren, Davies, and Emond 1975), 2) unpublished MDNR index station computer printouts (MDNR 1970-75), and 3) a Michigan State University technical report (Cole 1976). Numerous minor disagreements (listed in Appendix F) exist, however, between the data presented in 316(b) Tables 4.2-8 through 4.2-16 and the data as presented in the original works cited above. One major error is incorrectly labeling a spring gillnet catch as a trawl catch in Table 4.2-10 and later including these gillnet data in the total column for trawl catch, thus making all of the values for total catch and catches per unit of effort (CPE) incorrect. The effect of these errors is discussed in Section II-C-2.

2. Verification of 316(b) population estimates

Population estimates in the 316(b) were derived by Detroit Edison from the MDNR and ODNR trawl data (discussed above) using a calculation described by the following equation:

$$\frac{\text{catch/trawl}}{\text{area/trawl}} \times \text{ area of available habitat} = \text{population estimate} \qquad (6)$$

or

$$\text{catch/unit area} \times \text{area of available habitat} = \text{population estimate}$$

Although this equation permits calculation of an acceptable approximation of population size and was used consistently in the 316(b), inconsistent and erroneous descriptions of the calculation occur in the 316(b) text and tables:

(1) Indices of total population size of the major fish species in western Lake Erie were derived from trawl survey data (Michigan DNR, unpublished data; Van Vooren et al. 1975). Trawl catches were converted to catch per unit area trawled, which was then multiplied by the area of available habitat in the western basin to estimate total population size.

(p. 4.2-23)

(2) The population estimates were determined in the following manner. The trawl catch data were first expressed in terms of catch per unit area. The area covered by one unit of effort was determined by multiplying the width of the tow, calculated from the boat speed (6.4 kph or 4 mph) and the length of time of the tow. The population size was then determined from the product of the catch per unit area and the ratio of the area of the total available habitat (943 km^2 or 364 mi^2) to the area covered by one unit of trawl effort.

(p. 4.2-23)

(3) Estimates derived by multiplying catch per hour (Table 4.2-8) by the area covered in one hour of trawling (35-ft wide trawl by 4 mph) and dividing this into the area of habitat in Lake Erie (364 mi^2 or 30% of the western basin).

(Table 4.2-17:
Table 4.2-18 is similar)

(4) Estimates derived by multiplying catch per effort (Tables 4.2-9 through 4.2-15) by ratio of area of total available habitat (364 mi^2 or 30% of western basin) to area covered by one unit of trawl effort (33-ft wide trawl towed for 10 minutes).

(Table 4.2-19)

Examples 1 and 4 are correct descriptions and result in total catch; examples 2 and 3, however, yield $\frac{\text{catch}}{\text{area per effort}}$ and $\frac{h^2}{\text{catch}}$,respectively.

Despite the above inconsistencies, all but one of the population estimates, or population size indexes, presented in Tables 4.2-17 through 4.2-20 appear to have been correctly calculated. The one calculation error we found (in Table 4.2-18) overestimates the YOY shiner population by an order of magnitude (40,633,000 instead of 4,063,000).

The mislabeling in Table 4.2-10 (discussed in Section II-C-1) results in erroneous 1970 estimates in Table 4.2-19. Most of the 1970-75 mean estimates presented in Table 4.2-19 are thus also in error but by no more than 5%. Several other errors, most of which arise from errors made in Tables 4.2-8 through 4.2-16 are listed in Appendix F.

Although most of Detroit Edison's population estimates were calculated according to the correct formula using the data presented in the 316(b) and are free of arithmetic error, we believe that the estimates are biased in several ways:

a) The use of trawl catch data as the basis for population estimates is questionable and likely results in underestimates of true population size. The trawl data gathered by the MDNR (and probably also those collected by ODNR) were intended only as indexes of year-to-year relative abundance (R. C. Haas, MDNR, personal communication, August 10, 1977). Although we believe trawl catch data could have been adequate for estimating the population of age I and older yellow perch, we do not believe its use results in accurate estimates for all species. Detroit Edison acknowledges some of the limitations of using trawl catch data for population estimates on p. 4.2-23 of the 316(b):

> . . . Use of this type of data as a management tool is highly questionable because of natural variability in the data and the selective nature of the sampling gear. Since gill net and trapnet data cannot be quantified, these catch data could not be used in standing crop estimates. However, using conservative assumptions, such estimates can be used to predict minimal or conservative total population size for comparison with power plant fish impingement/entrainment data.
>
> The key conservative elements of this estimating technique are (1) the sampling gear was assumed to collect all of the fish in the area covered, and (2) the area covered was only a portion of the available habitat. Trawling, like most fish collection gear, is highly selective; that is, many fish are able to avoid or escape the net. The trawls used in these studies sampled only a small proportion of the water column near the bottom. Thus, use of trawl data to estimate density of fish-per-water-body area results in a significant underestimate of true population size.

b) The values used to calculate "area per trawl" (area of lake bottom covered per trawl tow) are incorrect and underestimate the standing stock of fish. The width given in the 316(b) for the MDNR trawl (33 ft) is the length of the trawl headrope (R. C. Haas, MDNR, personal communication, August 10, 1977). The width of the trawl opening while it is being fished would be smaller than the length of the headrope. The 316(b) calculations thus overestimate the area trawled and underestimate the population size (refer to Equation 6). The population estimates based on the ODNR data are probably similarly biased.

c) The value used in the 316(b) for "area of available habitat," stated to be 30% of the western basin area, or 364 square mi, also results in an underestimate of population size. Our planimetry readings of Lake Survey Chart No. 39 (National Oceanic and Atmospheric Administration 1974) for the west end of Lake Erie indicate that the area between 6 and 24 ft, defined in the 316(b) as available habitat, is approximately 40% of the basin area, or 485 square mi.

d) The manner in which Detroit Edison used the MDNR trawl data results in overestimates of the abundances of some species impinged at the Monroe plant. The 316(b) calculates mean CPE using data from two MDNR stations (Monroe and Sterling State Park) close to the Monroe plant site. Discussion with an MDNR official (W. Bryant, personal communication, August 17, 1977) revealed that during 1970-75 trawling by the MDNR could have been conducted at as many as three other stations in the Michigan waters of Lake Erie, in addition to the two used in the 316(b). During 1975 (the year considered in the impact analysis), trawling was conducted by the MDNR at a third station, near the Woodtick Peninsula approximately 10 mi south of the Monroe plant, but these data were not used in the 316(b). Inclusion of the data from this station would have lowered the 1975 mean CPE and population estimates for species including yellow perch, walleyes, shiners, alewife, smelt, trout-perch, and logperch.

3. Impingement impact as assessed in the 316(b) by percentage of source population lost

The 316(b) annual impingement impact assessment (Table 5.2-3) assumes 100% mortality of impinged fish and is based on the simple ratio of the number of fish impinged of a given species (Table 4.3-1) to the number of individuals of that species in the source population (Tables 4.2-17 through 4.2-20, Table 5.2-2). This approach requires that the impinged population be representative of the source population with which the comparison is being made (i.e., have the same size, age, and sex composition, etc.). In the 316(b), the values used for the numbers of fish impinged and the population estimates include fish of different combinations of age classes. Detroit Edison evidently made the assumption that the age distributions of the impinged population and the source population were identical, but this is not demonstrated in the 316(b). The age classes used in the population estimates are also not consistent (refer to Table 5.2-2). For example, the 316(b) population estimate for gizzard shad is the mean of the ODNR estimate which includes only YOY and the MNDR estimate which combines YOY and yearlings. The alewife population estimate is the mean of the MDNR estimate which combines YOY, yearling, and adults and the ODNR estimate which includes only YOY.

In addition to the concerns expressed above and in Section II-B-2 regarding the reliability of the values presented in Tables 5.2-2 and 5.2-3 of the 316(b), these tables also contain some values (transferred from Tables 4.2-17 - 4.2-20) that were previously identified as incorrect (refer to Appendix F).

Because Detroit Edison underestimated the numbers of fish impinged and failed to compare age-equivalent segments of the impinged and source populations, we do not believe that the effect of impingement losses at the Monroe plant is adequately assessed in the 316(b).